REMARKS

Applicants have received and carefully reviewed the Final Office Action mailed May 30, 2003. Claims 1-15 were rejected and remain pending. Claims 1, 2 and 14 have been amended and claims 3 and 4 have been cancelled. Claims 5, 8 and 11 have been to correct claim pendency in view of claim cancellation. Reconsideration and allowance of all pending claims are respectfully requested.

In part 2 of the Final Office Action, claims 1-4 were rejected under 35 U.S.C. §102(b) as being anticipated by *Donald*, U.S. Patent No. 3,404,203. After carefully reviewing the Examiner's arguments and the cited reference, Applicants respectfully disagree.

Claims 1, 2 and 14 have been amended as a clarification to the scope of these claims only. Applicants respectfully assert that these amendments do not claim new matter over the original claims. Elements of claims 3 and 4 have been added to claims 1, 2 and 14, and claims 3 and 4 have been cancelled. Specifically, the elements from claims 3 and 4 that describe the manipulation of the polymer while the polymer is between its glass transition and melt temperatures have been added to claims 1, 2 and 14. Because these amendments contain matter from claims that were reviewed by the Examiner in prior examinations, these amendments should not require a new search. In light of these amendments, Applicants respectfully traverse the rejection on several grounds.

First, *Donald* does not disclose imparting the helical orientation into the material while it is between the glass transition and the melting temperatures, whereas the current invention does do so. Second, Applicants believe that the die head is part of the extrusion system, that *Donald* imparts a partial helical structure *within* the extrusion system, and that the current invention imparts a helical orientation *after* the extrusion system. Finally, the current invention orients the

polymer using a different method than *Donald*. These arguments will be further explained below.

1) As mentioned above, claims 1, 2 and 14 were amended to clarify the scope of these claims. The amended claim language specifically states that the helical orientation takes place when the polymer is between the glass transition and melt temperatures. The elongate polymer member is rotated downstream of the extrusion head while the polymer is between these temperatures. *See* Specification, page 3, line 21 through page 4, line 2. The benefit of orienting the polymer when it is between these temperatures is that it orients the material at the molecular level through substantially the entire elongate polymer member and it allows for more rotations per lineal foot. *See* Specification, page 4, line 2-5. It is respectfully asserted that this process and the resulting benefits are not disclosed in *Donald*.

Donald describes a process wherein a mandrel (18) and a die (24) are rotated in order to impart a helical orientation on the inside and/or outside *surface* of a pipe. *See Donald*, column 2, lines 4-6 and column 3, lines 45-55. The Examiner stated that it is "inherent that the orientation process would take place while the polymer used by *Donald* is at a temperature [between the glass transition and the melting temperatures of the polymer]." *See* Final Office Action, page 3. Applicants respectfully submit that the opposite is true; it is inherent that the polymer is melted and is lacking significant crystalline structure in order for the *Donald* extrusion and orientation process to operate. In order to show inherency, the Examiner is required to show that it is necessarily true that the allegedly inherent characteristic flows from the teachings of the prior art. *See* M.P.E.P. § 2112. Here, it would have to be shown that it necessarily flows from the teachings of *Donald* that *Donald* imparts the helical orientation when the material is between its

glass transition and melt temperatures. The following points will show that this is not inherent in *Donald*.

Extrusion systems operate by heating a material past the melting point, so that the material is in a liquid, amorphous state. *See* Physics of Plastics, (Arthur W. Birley et al.) © 1992, pages 8-10 and 94 (a copy of this reference is attached hereto). The extruder then forms the material into the desired shape by forcing it through a pre-determined orifice, followed by a cooling process where the crystalline structure is allowed to reform. Indeed, the "process viability window" for continuous plastics processing operations "is defined by a lower-bound crystalline melting point (or a "maximum viscosity" constraint) and an uppermost temperature which is usually associated with the onset of thermal degradation." Physics of Plastics, page 94. If the material is allowed to cool below the melting temperature, but kept above its glass transition temperature, it is by definition in a rubber state, and outside the "process viability window." *See* Physics of Plastics, pages 8-10 and 94. The polymer viscosity would be above the "maximum viscosity" constraint. *See* Physics of Plastics, page 94. If the polymer in *Donald* were allowed to cool to below the melting temperature while it is still within the channel in which polymer travels (any point before it exits the rotating die (24)), it would essentially create a "plug" of very high viscosity polymer in its rubber state at the end of the channel, translating very high pressures back through the extruder. This would be outside the normal operating conditions for a typical extruder system. Because operation of the *Donald* process at the claimed condition would not be possible, Applicants respectfully assert that this is not inherent to the operation of the process described in *Donald*.

The equipment that is disclosed in *Donald* is further evidence that *Donald* did not intend to operate the extruder between the glass transition and melt temperatures. First, there is no

mention of protecting the equipment from the extreme pressures that would result from pumping a polymer in its high viscosity, rubber state. Second, there is no cooling system that is disclosed as part of the equipment. As disclosed in *Donald*, the material will be placed under a "circumferential shear" as well as the normal "linear shear force that is generated by the expulsion of the plastic material from the die." *Donald*, column 3, lines 6-8. "The rate of application of deformation (shear rate) in combination with the material's own resistance to flow (its shear viscosity) under the imposed conditions, contrives to create the generation of heat by mechanical means." Physics of Plastics, page 94. There is no evidence that the extrusion system in *Donald* intends to remove any of this thermal energy that will be generated by both the circumferential and linear shear. First, considerable thermal energy would need to be removed in order to cool the material below its melting point and into its rubber state. Then additional cooling capacity would be required to keep it below this melting point because of the heat generation resulting from the circumferential and linear shear. Further, the high viscosity resulting from a polymer in its rubber state would exacerbate the generation of heat because of the extremely high shear viscosity. In such an operation, a cooling system would be vital to cooling a material below the melt temperature and then to keep it below that temperature. There is no mention of such equipment.

All of this is evidence that *Donald* does not disclose a process in which the material is helically oriented while between its glass transition and melt temperatures. The Examiner contends that it is inherent that the orientation in *Donald* takes place between the glass transition and melt temperatures. However, "in relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art."

MPEP § 2112, emphasis in original. In light of the arguments above, it does not necessarily flow from the disclosure in *Donald* that the helical orientation takes place between the glass transition and melt temperatures. In fact, the above arguments indicate that the opposite is true – that the process in *Donald* inherently does not operate within this temperature range, but operates in the temperature range of conventional extrusion systems.

2) On page 8 of the Final Office Action, it is asserted that the extruder (10) described in *Donald* does not include the rotating die (24), even though the die (24) is included in the description of the extruder. The Applicants respectfully disagree. The "functional parts of a typical single screw plastics extruder [are]: 1) feed hopper (gravimetric discharge); 2) screw; 3) barrel; 4) electric heaters; 5) *die body*; …" Physics of Plastics, page 98 (emphasis added). Just as the feed hopper is part of the extruder because an extrusion system must be fed with raw material, a die body is part of an extruder because an extrusion system must force the polymer through some pre-determined shape in order to accomplish the purpose of shaping the material. Therefore, the die head (24) in *Donald* is part of the extruder.

The extruder head (20) in the current invention is the part of the extruder that forms the desired hollow cylindrical shape. "The bilateral form of the extruded product is determined by the extrusion die." Physics of Plastics, page 99. Therefore, by definition, this extruder head (20) is the die head of the extruder. The current invention imparts a helical structure after the material has exited the extruder head (20), whereas *Donald* attempts to helically orient the material within the die head (24). Therefore, the current invention performs the orientation process after the extruder, unlike the *Donald* process, in which the orientation takes place within the extruder. This is made clear with the claim language "downstream of the extrusion head," which, as

mentioned above, is functionally equivalent to being downstream of the extrusion die. *See* Applicants' claim 1.

3) The equipment in the current invention also imparts the helical orientation in a different manner than *Donald*. *Donald* discloses a process that imparts a partial helical structure on the outer surface layers of the material by contact between the rotating die head (24) and mandrel (18) and the surface layers of the material. The helical orientation is imparted through total surface-to-surface contact with a piece of extrusion equipment (the die head (24) or mandrel (18)). It is the intent of the current invention to impart the helical orientation to the material after it has exited the extrusion system, when it is no longer in total surface-to-surface contact with the extrusion equipment. Claim 1 of the current invention makes it clear that the invention that is claimed rotates the material when the material is no longer in total surface-to-surface contact with extrusion equipment. Again, this is made clear with the claim language "downstream of the extrusion head," which, as mentioned above, is functionally equivalent to being downstream of the extrusion die. *See* Claim 1. Thus, the orientation occurs when the material is no longer in total surface-to-surface contact with the extrusion equipment.

4) In summary, *Donald* does not disclose the current invention. There are at least three differences between the two processes: the state that the polymer is in when the helical orientation occurs, where the helical orientation occurs in the process, and how the orientation is imparted. The *Donald* process does not disclose imparting of a helical orientation while the material is between the glass transition and melt temperatures, whereas the current invention claims manipulation in this temperature range in order to impart substantially complete helical orientation. The *Donald* process only imparts a helical orientation to the *surface* of the material, whereas the current invention achieves substantially total helical orientation of the material by

imparting the orientation when it is between the glass transition and melt temperatures. Finally, this helical orientation is imparted after the extrusion system and after the material has exited the extruder head (or die head), when there is no longer total surface-to-surface contact between the material and the extrusion equipment. This allows the entire structure to be rotated rather than only the material that is close to the inner and outer surfaces, and this imparts a substantially complete helical orientation to the product. It also allows the manipulation to occur between the glass transition and melt temperatures without extreme pressures being translated back through the extruder. Applicants respectfully assert that *Donald* does not disclose all the elements of claim 1, and this claim is allowable. Because independent claim 1 is allowable, dependent claims 2-4 are also allowable for the above stated reasons.

On page 3 of the Final Office Action, claims 1-15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Donald*, U.S. Patent No. 3,404,203 in view of *Wang et al.*, U.S. Patent No. 5,951,494. After carefully reviewing the Examiner's arguments and the cited references, Applicants respectfully disagree.

Donald describes a process wherein the plastic is melted and, while it is molten, the polymer is subjected to circumferential shear in order to promote better mixing and alleviate the issue of weld lines in pipes. *Donald* describes a process in which the helical orientation is imparted only on the outer surfaces of a pipe. *Donald* discloses a process that "molecularly [orients] the heat plastified material adjacent the *inner and outer walls*...." *Donald*, column 5, lines 22-24 (emphasis added). The invention would provide "a helically oriented interior *surface*" and "the external *surface* would be oriented in the left hand helical pattern." *Donald*, column 3, lines 10-13 (emphasis added). *Donald* does not disclose a method for orienting substantially all of the material in a helical orientation. *Donald* does not disclose orientation of

substantially the entire structure in order to provide for increased torsional strength. *Donald* does not disclose orienting the polymer by turning the entire product after the product has exited the entire extrusion system. *Donald* does not disclose the orientation of the polymer when the polymer is between the glass transition and melt temperatures.

Wang et al. disclose taking a non-helically oriented tube, heating it up to between the glass transition and melt temperatures, and then twisting the structure while it is in this partially crystalline state in order to impart a helical orientation to the entire product. *Wang et al.* do not disclose an extrusion process, but discloses a two-step process for production of a helically oriented tube, the raw material being discrete, substantially linearly oriented tubes or cylinders.

Neither *Donald* nor *Wang et al.* disclose, in isolation or combined, an extruder that forms a tube and then, when the tube is no longer in total surface-to-surface contact with the extrusion equipment, twisting the tube while it is still between the glass transition and melt temperatures. Therefore, *Donald* and *Wang et al.* do not disclose all claim limitations as required under MPEP §2143.03.

On page 5 of the Final Office Action, it is stated that "one having ordinary skill in the art at the time of the invention would have further been motivated to use the process of *Donald* to make the product of *Wang et al.* because it would save energy by removing the need to reheat the member to above the glass transition temperature." However, as mentioned above, *Donald* will not orient substantially all of the polymer, but only the surface. *Donald* does not satisfy the burden of showing a prima facie case of obviousness because there is no evidence that it will accomplish the objective, which is to helically orient substantially the entire structure. In fact, *Donald* states that it will not accomplish this objective. As mentioned earlier, language in *Donald* states that the helical structure is not imparted throughout the product, but only on the

surfaces. In addition to showing that the *Donald* process would not be successful in accomplishing the objective of orienting substantially all the material in the product, this lack of success also shows that there is no motivation for using the process described in *Donald*. Because there is evidence that *Donald* will not be successful in accomplishing the objective of the current invention, reference to *Donald* fails to make a prima facie case of obviousness under MPEP §2143.01 (no suggestion or motivation in the art) and §2143.02 (no reasonable chance of success).

Because *Donald* and *Wang et al.* do not disclose all the claim limitations of the current invention and because there is evidence that *Donald* will not accomplish the objective of the current invention (which is also evidence of lack of motivation), the current invention is not obvious in view of *Donald* and *Wang et al.* For these reasons, Applicants respectfully submit that claim 1 is allowable. Because independent claim 1 is allowable, dependent claims 2-15 are also allowable for the above stated reasons, and because they contain other elements.

On pages 7-8 of the Final Office Action, claims 14-15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Donald*, U.S. Patent No. 3,404,203 in view of Wang, U.S. Patent No. 5,951,494. After carefully reviewing the Examiner's arguments and the cited references, Applicants respectfully disagree.

On pages 7-8 of the Final Office Action, it is stated that "it would have been obvious to one having ordinary skill in the art at the time of the invention that in order to impart two different orientations, that a first inner member of one orientation would have to be made by the process of *Donald*, then passed back through the process of *Donald* and used as the core member in order to impart a second orientation to the second layer." As mentioned in the previous sections, *Donald* does not teach the current invention, and *Donald* and *Wang et al.* in

combination do not disclose all the elements of the current invention, nor will *Donald* be successful in accomplishing the objective of the current invention. Because claim 1 should be allowable under the prior sections, claims 14 and 15, dependent upon claim 1, should also be allowable.

However, claims 14 and 15 also have at least one additional element that is not disclosed in the prior art. The addition is a guide tube (28) in the extruder through which to pass a wire or a preformed product. *Donald* describes a process in which pipe is formed, but the central mandrel (18) does not include a passage through which to pass a wire or a previously formed element. Because this claim limitation is not disclosed in the referenced prior art, it is not obvious under MPEP § 2143.03. Because claim 1 is allowable for the reasons stated above and because claims 14 and 15 add at least one significant element that distinguishes them from the prior art, Applicants respectfully submit that dependent claims 14 and 15 are allowable.

Reexamination and reconsideration are respectfully requested. It is respectfully submitted that all pending claims are now in condition for allowance. Issuance of a Notice of Allowance in due course is requested. If a telephone conference might be of assistance, please contact the undersigned attorney at (612) 677-9050.

Respectfully submitted,

Albert Chin et al.

By their Attorney,

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David M. Crompton, Reg. No. 36,772
CROMPTON, SEAGER & TUFTE, LLC
1221 Nicollet Avenue, Suite 800
Minneapolis, MN 55403-2420
Telephone: (612) 677-9050
Facsimile: (612) 359-9349